APTITUDES ACROSS HOLLAND'S TYPES: IMPLICATIONS FOR SCHOOL-BASED COUNSELLING

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ABSTRACT. School-based counsellors use (objective) measures of aptitudes as part of their normal career assessment practice; thus, training programs for school and college counsellors need to provide more relevant training in the use of tests, especially aptitude tests. In this study, differences in aptitudes – as measured by the DAT-A (McBride, 1986) – were examined across Holland's (1985/1992) types. The results generally conform to Holland's descriptions of types, particularly when Intelligence (general ability, or *g*) is partialed out of specific aptitude scores. Implications are discussed for career theory and related assessment practice.

RÉSUMÉ. Les conseillers scolaires utilisent des mesures (objectives) des aptitudes dans le cadre de leurs méthodes normales d'évaluation des carrières, ce qui explique que les programmes de formation destinés aux conseillers scolaires et collégiaux doivent comporter un volet de formation plus pertinent en ce qui concerne l'utilisation des tests, surtout des tests d'aptitudes. Dans cette étude, les différences d'aptitudes (telles que mesurées par le DAT-A (McBride, 1986)), sont analysées selon les types de Holland (1985/1992). Les résultats concordent généralement avec les descriptions des types de Holland, particulièrement lorsque l'intelligence (c'est-à-dire l'aptitude générale ou g) est écartée des scores d'aptitudes spécifiques. L'auteur analyse les implications en ce qui concerne la théorie professionnelle et les méthodes d'évaluation connexes.

Career counsellors based in educational settings often include testing as part of their work with clients. Two of the most commonly used types of tests for such purposes include interest inventories and aptitude tests, and principles of sound practice dictate that counsellors using such tests should understand their relations to one another. This is a problem in which empirical research can make an important contribution to counselling practice. The problem of the relations between aptitudes and interests was at one time an active area of investigation but ceased to

be so around 1950 (see Randahl, 1991). The early investigators found product-moment correlations between measures of interests and aptitudes typically fell in the .20 to .40 range, and only rarely rose above .40, although some multivariate (canonical) correlations did rise above .50 (Randahl, p. 333). The consensus was that aptitudes and interests represented fairly distinct realms (Darley & Hagenah, 1955), with few consistent points of convergence, and that their interactions were complex beyond being adequately revealed by the methodologies at hand.

Although this consensus still exists (see Barak, 1981, p. 1; Lowman, 1993a; Spokane, 1993), recent research on Holland's (1985/1992; see Carson, 1994; Spokane, 1996) theory of vocational personality types has suggested new routes for reconsidering the relations between aptitudes and interests. Holland proposed the existence of six types of people: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. He argued that these types had characteristic interests, personality traits, aptitudes, and other traits. Finally, he suggested that a person-environment fit approach to matching people to corresponding jobs would result in optimal vocational outcomes. His theory has been tremendously influential in the field of career counselling and related assessment (Spokane, 1996). Pertinent to the present discussion is Holland's assumption of an essential convergence of interest and aptitude data as they contribute to stabilization of vocational personality. If vocational personality types are indeed integrations of aptitudes and interests (as well as other characteristics), then aptitudes and interests must be more closely related than the "consensus" indicates. This point clearly differentiates Holland's theory from otherwise similar theories (e.g., Lowman's [1993] inter-domain model, or Dawis' [1996] theory of work adjustment) that allow (and even assume) that aptitudes and interests are largely unrelated.

The most important of the new research indicating relatively strong associations between interests (organized within Holland's types) and aptitudes is Randahl's (1991) study reporting individual differences in scores on the General Aptitude Test Battery (GATB; U.S. Department of Labor, 1970) across individuals differing in vocational personality type (as indicated by high-point codes on the General Occupational Themes [GOT's] of the Strong Interest Inventory [Harmon, Hansen, Borgen, & Hammer, 1994]. She used the eight "pure" aptitude tests from the GATB, dropping General Learning Ability (G) because of its "composite nature" (p. 338). Relying primarily on profile analysis rather than correlational methods, Randahl found that interest-based voca-

tional types differed in aptitudes in ways generally predicted by Holland's theory. She also found that aptitude-based types created by high-point scores on the GATB aptitude scales **also** differentiated individuals on the basis of interest-based vocational personality types. For example, individuals highest in Spatial aptitudes tended to be highest in Realistic interests, while those with highest aptitudes on the Verbal test scored most highly on measures of Artistic interests.

However, inspection of Randahl's (1991) results (p. 341) suggests that Investigative types tend to be highest or near the highest for each of the aptitudes. Given that she found that Investigative types were also highest on the G scale of the GATB, these results suggest that Investigative types may have scored so high on the various scales because they had higher general ability, and that each of the various tests also to some degree measured general ability, therefore resulting in high scores for each of these tests for investigative-type individuals. Randahl's results might have provided even more striking linkages between interest types and aptitudes had the variance in the various GATB scales associated with general ability first been statistically removed. Desmarais and Sackett's (1993) strategy of statistically removing the contribution of General Ability (g, or Intelligence) by regressing individual aptitude test scores onto a composite index of g would appear to offer a useful means of "fine-tuning" the relations between **specific** abilities and interests that Randahl sought to test. To that end, I conducted this study.

METHOD

Respondents

One hundred seventeen clients of the Vocational Assessment Project (VAP) located in the Faculty of Education at McGill University (in Montreal) served as participants (82 women, 35 men; mean age 26.28 years, *SD* = 9.04). Eight additional individuals who had received services were not included in this study because they did not complete some or all of the aptitude testing component. Respondents reported their ethnicity: English or French descent (English only: *N* = 38 or 32%; Bicultural English/French: *N* = 10 or 9%), Other European non-Jewish (*N* = 46 or 39%), Jewish (*N* = 9 or 8%), and all others (African-, Arab-, East Asian-, South Asian-, Latin American-Canadians, and other: *N* =14 or 12%). Clients were drawn from several sources. A majority of clients were either referred through a university's counselling service or by master's degree counselling students working in community-based

practicum settings. The remainder were self-referred, presumably after hearing about the project by word of mouth.

Instruments and Procedure

In addition to a biographical history questionnaire and a measure of personality (Myers Briggs Type Indicator, Myers & McCaulley, 1985; the results of which are not reported here), respondents completed measures of aptitudes and interests. They completed the biographical history questionnaire prior to arriving at the assessment laboratory. They completed the aptitude, interest, and personality tests during an approximately three-hour period at the laboratory. Order of presentation of these three measures was randomly assigned to respondents.

INTELLIGENCE AND APTITUDES. The Differential Aptitude Tests-Adaptive (DAT-A) (McBride, 1986; Moe, 1988) served as the measure of aptitudes and provided the dataset from which estimates of general cognitive ability (g) or Intelligence were generated. Its content was derived from the Form V version of the DAT (Bennett, Seashore, & Wesman, 1982), with which it has been equated (Henly, Klebe, McBride, & Cudeck, 1989; McBride, 1986). The DAT-A has the same eight tests as the original paper-and-pencil DAT: Verbal Reasoning, Numerical Ability, Abstract Reasoning, Clerical Speed, Mechanical Reasoning, Space Relations, Spelling, and Language Usage. DAT-A selects items as each test proceeds based on analysis of DAT items using the Rasch (1966) model of item-response theory. Bennett et al. (1982, pp. 7-10; see also Carson, Stalikas, & Bizot, in press) provide a discussion of the psychometric characteristics for each test, and Spokane (1991) reports that psychometric evidence related to the original paper-and-pencil DAT is quite supportive. McBride (1986) and Henly et al. (1989) report factor analytic and other data supporting the comparability of the paper-and-pencil and the adaptive versions of the tests; however, they suggest that adaptive Clerical Speed (the only speeded test in the battery) may assess a somewhat different underlying construct than the original test.

For purposes of the present research, raw scores for the DAT-A were used instead of the sex-based norms. Use of sex-based norms might have obscured actual differences in aptitudes across types, particularly where large sex-related differences existed in interests. However, in making actual career guidance recommendations to clients, counsellors made use of all available relevant data, including sex norms.

INTERESTS. The General Occupational Themes (GOTs) of the fourth edition of the Strong Interest Inventory (SII; Hansen & Campbell, 1985; see Harmon et al., 1994) served as the measures of interests. Hansen and Campbell review substantial validity and reliability evidence for the scales of the measure, including evidence in support of its use with cross-cultural populations. Respondents were assigned to vocational personality types (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional) on the basis of high-point codes for the GOTs. In cases of ties, type assignment was made randomly between the tying scales.

Procedure

Clients were referred to the VAP by their counsellor or through self-referral. They brought their biographical questionnaire to their scheduled computerized testing session, where they completed the SII, DAT-A, and a personality test. The laboratory session took between 2.5 and 4.5 hours. Some clients may have taken longer to complete testing because of crowded conditions on some testing days. The administration order of tests was randomly assigned to clients to control for order effects. Following completion of testing, clients met with a counsellor. Counsellors included a counselling psychologist, a master's level counsellor licensed in the province, and graduate students in a counselling psychology training program. When necessary, clients were referred back to their initial agencies for further work (among those clients obtained through agencies), or were referred to an appropriate community-based career counsellor or agency (for those clients who were self-referred).

RESULTS

Principal components analysis was conducted on the sample of 117 respondents from whom a complete set of DAT-A scores were available. The analysis resulted in two factors with an eigenvalue greater than one; these two factors were retained for inspection (see Table 1). Factor 1 appeared to be the familiar General Cognitive Ability (*g*) or Intelligence factor typically found as the first and major factor in unrotated solutions, with each of the DAT-A scales loading heavily on it. Hereafter, I shall refer to this factor as "Intelligence." Factor 2 was more difficult to interpret in the unrotated matrix, but at any rate showed a mix of positive, negative, and neutral loadings of DAT-A scales, and was therefore clearly not an indicator of *g*. Factor scores were generated for all respondents for whom DAT-A scores were available,

and these scores served as the measure of Intelligence used in subsequent analyses. Means and standard deviations for the variables used in the study are shown in Table 1. (N = 117 for all subsequently reported analyses unless otherwise noted).

TABLE 1. Means and standard deviations of variables and principal components analysis of DAT-A scales

Scales and Component Information	Descriptive statistics		Component loadings	
	Mean	SD	I	II
DAT-A Scales[1]				
Verbal Reasoning	33.40	11.47	.86	.03
Numerical Ability	29.50	9.03	.79	.06
Abstract Reasoning	36.21	7.45	.73	-.26
Clerical Speed & Accuracy	44.97	10.44	.54	.15
Mechanical Reasoning	46.57	9.66	.69	-.52
Space Relations	39.05	13.58	.80	-.41
Spelling	81.55	8.05	.61	.69
Language Usage	39.44	6.85	.77	.37
Eigenvalues			4.23	1.14
Variance Explained by Components			54.53	13.23
General Occupational Themes[2]				
Realistic	44.32	9.67		
Investigative	45.23	9.79		
Artistic	49.98	10.15		
Social	50.88	9.12		
Enterprising	45.11	9.45		
Conventional	46.81	10.56		

N = 117.
[1]Scales were drawn from the Differential Aptitude Test-Adaptive (DAT-A; McBride, 1986). Only components with eigenvalues > 1 were retained.
[2]General Occupational Themes are drawn from the Strong Interest Inventory (Hansen & Campbell, 1985).

Intelligence correlated with the GOT scales at .26 ($p < .01$), .40 ($p < .001$), .18, .03, -.23 ($p < .02$), and -.14 for the scales Realistic, Investigative, Artistic, Social, Enterprising, and Conventional, respectively. The patterns of magnitude and signs of these correlations fit the hexagonal structure described by Holland (1985/1992), with the strongest positive and negative correlations being with the Investigative and Enterprising GOTs, respectively. Correlations between the various DAT-A scales and the GOTs are shown in Table 2.

TABLE 2 Correlations between DAT-A and GOT scales

	DAT-A Scales								
Scales	*g*	VR	NA	AR	CS	MR	SR	SP	LU
VR	.86*	–							
NA	.79*	.60*	–						
AR	.75*	.60*	.55*	–					
CS	.57*	.35*	.43*	.42*	–				
MR	.70*	.58*	.48*	.40*	.30*	-–			
SR	.79*	.62*	.54*	.60*	.36*	.71*	–		
SP	.64*	.51*	.46*	.30*	.42*	.23*	.47*	–	
LU	.78*	.72*	.56*	.47*	.26*	.41*	.79*	.63*	–
R	.26*	.21*	.09	.21*	.02	.39*	.30*	.03	.19*
I	.40*	.39*	.27*	.20*	.16	.43*	.33*	.28*	.27*
A	.18	.19*	.07	.15	.08	.11	.06	.18	.17
S	.03	.08	-.04	.09	-.01	-.06	.02	.06	.05
E	-.23*	-.16	-.26*	-.10	-.13	-.11	-.17	-.25*	-.22*
C	-.14	-.19*	-.04	-.04	.01	-.17	-.18	-.04	-.13

N = 117. Correlations are Pearson product-moment correlations. *$p < .05$. Differential Aptitude Test-Adaptive (DAT-A; McBride, 1986) scales include Verbal Reasoning (VR), Numerical Ability (NA), Abstract Reasoning (AR), Clerical Speed and Accuracy (CS), Mechanical Reasoning (MR), Space Relations (SR), Spelling (SP), and Language Usage (LU). Intelligence (*g*) is the factor score for Factor I from the principal components analysis of the DAT-A scales. General Occupational Themes (GOTs) from the Strong Interest Inventory (Hansen & Campbell, 1985) include Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E), and Conventional (C).

Table 3 shows the means and standard deviations across the six vocational personality types for Intelligence and the various DAT-A scales (both raw scores and Z-scores). The table also shows the DAT-A scores with intelligence statistically partialed out. Although Investigative-type individuals have the highest aptitude scores for every aptitude except Mechanical Reasoning (for which Realistic-type dominates Investigative, albeit just barely), the picture changes dramatically once Intelligence is partialed out of aptitude scores. Such "*g*-less" scores generally conform more closely with Holland's descriptions for the various types (at least for Realistic, Conventional, and perhaps Enterprising types).

For example, Realistic types are revealed to be extremely high (relative to other types) for both mechanical and spatial aptitudes, and they score the lowest on measures of numerical aptitude, clerical speed, spelling, and language usage. However, their spelling and language

TABLE 3. Means and standard deviations of variables across vocational personality types

Variable Set and Variable	Vocational Personality Types					
	R (N = 9)	I (N = 10)	A (N = 31)	S (N = 34)	E (N = 15)	C (N = 18)
Intelligence						
Mean	-.12	.74	.03	.02	-.35	-.12
SD	1.33	.58	.99	1.00	.95	.95
DAT-A (*Z*-scores)						
Verbal Reasoning (VR)						
Mean	.05	.72	.04	.05	-.34	-.30
SD	1.02	.55	1.04	.97	.93	1.10
Numerical Ability (NA)						
Mean	-.35	.44	-.11	.10	-.35	.21
SD	1.37	.78	1.06	.84	1.01	1.01
Abstract Reasoning (AR)						
Mean	-.13	.48	-.09	.02	-.13	.01
SD	1.37	.59	1.01	1.08	.81	.99
Clerical Speed and Accuracy (CS)						
Mean	-.50	.30	.18	-.10	-.20	.13
SD	1.18	1.05	.63	1.07	1.39	.86
Mechanical Reasoning (MR)						
Mean	.64	.41	.07	-.13	-.14	-.32
SD	.91	.36	1.03	1.10	.99	.92
Space Relations (SR)						
Mean	.27	.53	-.09	.08	-.10	-.34
SD	1.10	.64	1.06	.97	.92	1.08
Spelling (SP)						
Mean	-.66	.76	.10	.06	-.65	.15
SD	1.22	.14	.83	.87	1.59	.61
Language Usage (LU)						
Mean	-.28	.69	.05	.02	-.28	-.13
SD	1.29	.69	1.06	1.12	.67	.77
DAT-A (*Z*-Scores, Intelligence removed)						
Verbal Reasoning (VR-R)						
Mean	.32	.12	.05	.06	-.08	-.37
SD	.99	.65	.91	1.14	1.20	.83
Numerical Ability (NA-R)						
Mean	-.40	-.23	-.21	.14	.11	.50
SD	1.37	.95	1.10	.69	.86	1.15
Abstract Reasoning (AR-R)						
Mean	-.06	-.14	-.16	.02	.23	.17
SD	1.01	.60	1.14	1.10	1.05	.71
Clerical Speed (CS-R)						
Mean	-.53	-.14	.21	-.13	.01	.24
SD	.98	1.00	.83	1.05	1.35	.85
Mechanical Reasoning (MR-R)						
Mean	1.03	-.20	.08	-.21	.16	-.32
SD	.63	.53	1.01	1.11	1.03	.79
Space Relations (SR-R)						
Mean	.61	-.11	-.17	.09	.31	-.39
SD	.86	.64	1.14	.84	.99	1.11
Spelling (SP-R)						
Mean	-.73	.36	.11	.06	-.53	.31
SD	.99	.44	.72	.94	1.65	.80
Language Usage (LU-R)						
Mean	-.28	.17	.05	.01	.01	-.04
SD	.99	.91	.91	1.10	1.04	1.12

N = 117. High scores on General Occupational Themes (GOTs) from the Strong Interest Inventory (Hansen & Campbell, 1985) were used to classify participants into vocational personality types; these types included Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E), and Conventional (C). Differential Aptitude Test-Adaptive (DAT-A; McBride, 1986) scales are reported from *Z*-scores.

usage appear to remain relatively atrocious even when Intelligence is partialed out, although *g*-less verbal reasoning jumps to the head of the pack after Intelligence is removed, suggesting that Realistic types may possess some specific strong verbal competencies that are fairly distinct from those associated with Intelligence. With Intelligence "removed," the Realistic-type individual appears to have strengths in hands-on areas that make use of spatial and mechanical abilities, as well as perhaps the "naming" of things (as tapped by the Verbal Reasoning test), as well as major deficits in the fine points of linguistic conventions (i.e., spelling, grammar).

Conventional types score lowest on measures of verbal reasoning, mechanical reasoning, and spatial abilities, but highest on measures of clerical speed and numerical ability. They are detail-oriented and have strong numerical competencies, and show deficits in spatial, mechanical, and the same verbal area in which Realistic types are strong. In fact, their specific aptitude pattern is more or less the exact opposite of the Realistic type; where Realistic is strong, Conventional tends to be weak, and vice versa.

Removing Intelligence from aptitude scores has an interesting effect on the relative magnitudes of aptitudes between Investigative and Enterprising types. It appears clear that once Intelligence is removed, Investigative types no longer dominate the aptitude picture, except perhaps in such areas as spelling and language usage. Once Intelligence is removed, Enterprising types turn out to have the **highest** specific ability for abstract reasoning. They have higher *g*-less aptitudes than Investigative types for abstract reasoning, numerical ability, clerical speed, mechanical reasoning, and spatial ability – in short, any ability that is not specifically linguistically oriented. However, as with Realistic types, Enterprising types remain extremely poor spellers even **after** Intelligence is removed.

The removal of Intelligence from aptitude scores has essentially no effect at all on the relative magnitude of aptitude scores for either Artistic- or Social-type individuals. It is interesting to note that the differences between Investigative and Artistic aptitude scores essentially disappear once Intelligence is partialed out, except that the spelling remains stronger (although moving in the direction of Artistic-type scores) and the clerical speed becomes relatively worse among Investigative types in the *g*-less condition. In fact, the *g*-less clerical speed of Artistic types is almost the same as the relatively high-scoring Conventional types, suggesting that these types may share a common

perceptual speed ability that remains relatively independent of Intelligence. Randahl (1991, p. 341) also found that compared to other types Artistic types scored highly on measures of clerical perception aptitude.

DISCUSSION

This study will be of limited interest to those who doubt the usefulness of specific abilities in applied contexts. I and others (Carroll, 1993, p. 634 and 637; Desmarais & Sackett, 1993; Spearman & Jones, 1950) have suggested that they are useful and real, and that for purposes of fine-tuning the recommendations of the career counsellor they may prove as important as Intelligence, but others (e.g., Harrington, 1995) have questioned the need for *any* objective assessment of specific aptitudes at all in the context of career assessment. Probably the major limitation of this study is its reliance on very small sample sizes for many of Holland's types, particularly Realistic, Investigative, Enterprising, and Conventional types. This small sample size led to my decision not to test for sex differences in most analyses, and in general to rely more on comparisons of absolute magnitude of profiles rather than tests of statistical significance. Thus, this study should be considered primarily exploratory and descriptive. The sample was also restricted to career clients, which may account for the relatively larger representation of Artistic- and Social-type individuals (who tend to seek out counselling assistance for career problems). The use of a largely European-Canadian sample may limit the generalizability of findings to other populations. On the other hand, the results were fairly clear-cut, at least as regards the effects of removing Intelligence on the relative magnitude of aptitude scores across the types, and I anticipate that the results would generalize fairly well to additional samples. And given that there are so few tests of Holland's theory using Canadian samples of any sort, this investigation's reliance on Canadians of restricted ethnic background might perhaps be forgiven. However, future research of this sort should, of course, broaden ethnic representation to other groups.

The results of this study provide support for and to some degree extensions of Holland's (1985/1992) descriptions of vocational personality types (also see Lowman, 1991). This study confirms that Intelligence (relatively high *g*) is the hallmark of the Investigative individual. However, when Intelligence is (statistically) removed, such a person is left with some specific verbal skills and not much else (at least, not much else as measured by the DAT-A). By inference, what contributes most to success among *non*-Investigative workers may be the specific

aptitudes that Investigative persons tend not to share to any great degree. For example, Realistic types have strong Mechanical and Spatial abilities, while Conventional ones possess strong Clerical and Numerical abilities. This study was somewhat less successful in differentiating Enterprising, Social, and Artistic types from the others on the basis of Intelligence and special aptitudes, although even for these types the results suggested some patterns of specific aptitudes unique to these types. Perhaps the use of additional aptitude tests than those included in this study would provide a basis for more clearly differentiating these types from others. For example, Lowman (1991) argues that there are tests of creativity and social abilities that can differentiate these types. The finding that there exists a **negative** correlation between Intelligence and interests in Enterprising and Conventional areas is particularly interesting, in that it suggests that extremely intelligent individuals may shy away from such fields, this despite some evidence that success in fields related to business and leadership may be particularly associated (positively) with Intelligence (see Bizot & Goldman, 1993, p. 24).

These findings have implications for career practice in schools and the workplace, particularly for those counsellors basing their work on Holland's theory. The results in general support the use of vocational personality types as a way of conceptualizing clients: aptitudes and interests do generally relate to one another in ways predicted by the theory. However, the degree to which they do so, while moderately robust, is nevertheless imperfect. There will be clients with Realistic interests who nevertheless lack strong Spatial and Mechanical aptitudes. There are Conventional individuals (based on interests) who lack strong Numerical or Clerical aptitudes. Some Investigative types may be high in Intelligence and little else, which has interesting implications for career recommendations: what sorts of occupations are most suitable for a "pure *g*" individual? The upshot is that although aptitudes and interests may converge much of the time, they do not do so all of the time. Given that prediction of future job performance of career clients is much stronger when based on objectively measured aptitudes than on the basis of interests (Bizot & Goldman, 1993; see Dawis, 1996), and given that such prediction is a primary reason why students and other clients receive career counselling in the first place, I recommend that counselors use (objective) measures of aptitudes as part of their normal career assessment practice. However, because training programs for career counsellors often provide woefully inadequate training in the use of objective measures of specific aptitudes (see Watkins, Campbell, & Manus, 1990), we also need to invigorate

and make more relevant our graduate counsellor training programs by revising their curricula to incorporate experience with such tests.

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